Invertebrata

Tasmania's Invertebrate Newsletter

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Missing:

Contributions from University of Tasmania zoologists and zoology students. We know they're doing research on Tasmanian invertebrates (see *Invertebrata* 19, March 2001), but they seem reluctant to tell us about it. We'll keep asking, though!

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Invertebrata is produced by the Queen Victoria Museum and Art Gallery, Launceston, Tasmania.

We publish articles and short notes on all aspects of invertebrate biology and conservation in Tasmania.

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Bede Lowery and those Fire Ants

Owen Seeman & Lionel Hill

The Red Imported Fire Ant (RIFA), *Solenopsis invicta*, was detected in Brisbane in early 2001. The discovery made headlines and will continue to do so as eradication of this pest is attempted. All States and the Federal Government will contribute up to $123 million to a five-year eradication project. Certain suburbs of Brisbane will be the focus of this campaign. It is big! Compare this to the $30 million or so expended in the successful Papaya Fruit Fly eradication effort around Cairns in the late 1990s. Quarantine regulations for the interstate movement of pot plants, agricultural equipment and other risky items have been amended through multilateral negotiations that kept Queensland and the unafflicted states reasonably happy in a compromise. So far, the only infestation outside southeast Queensland occurred in Melbourne from potted palms imported from Brisbane. It was quickly eradicated.

The eradication plan has a three-year action phase followed by a two-year monitoring and mopping-up phase. It involves a big public relations program. The current distribution of fire ants in Brisbane, along with information and pictures, can be found at the RIFA website: **www.dpi.qld.gov.au/fireants**.

Tasmania's Department of Primary Industries, Water & Environment (DPIWE) will look for evidence of RIFA in Tasmania this summer when high temperatures favour detection of RIFA. In the meantime DPIWE is handling more ant identifications than usual as a result of media coverage of RIFA.

What are fire ants?

The Red Imported Fire Ant is native to the Paraguay River catchment in South America. Its native habitat is subject to frequent flooding and drying events, so the species is well suited to open areas disturbed by human activity. Fire ants make subterranean nests of about 150 000 workers (and up to 500 000) that are recognised by mounds (up to 40 cm high) above ground level. Despite having large colonies, fire ants can relocate their nest very quickly.

RIFA defend their nests aggressively against any perceived threat. Ants will rush from the nest, climb all over their attacker, and – on the release of an alarm pheromone – sting in synchrony. The sting of fire ants is particularly painful. They can sting repeatedly and will continue to sting even after their venom glands are empty. Their large nests, aggressive nature and painful stings make the fire ant a frightening pest in urban and agricultural areas. Some people have fatal allergic reactions to proteins in RIFA venom. The proportion of allergic people is much greater than for honeybee stings.

Two types of RIFA are known overseas: one type has single queens in each nest, the other has multiple queens. An ant species that has colonies with multiple queens is called *polygynous*. Nests with multiple queens are more problematical because new nests established by a polygynous colony are not aggressive to each other or to the parent colony. The result can be a nest-system that extends over hundreds of metres – similar to the huge nest systems of Argentine Ant.

Economic impacts

Fire ants have kept many entomologists employed in the USA, as can be seen from article titles in the *Journal of Economic Entomology* through the 1980s and 1990s. It is virtually a research industry!

Fire ants are a major pest of economic and social importance. Dollar values can be

(continued on p. 3)

Editorial

Last summer we extended our house in Penguin, and a few cubic metres of excavated soil wound up in a heap on our back lawn. Over the next six months, the heap became home to a range of exotic invertebrates. On casual visits to the heap I found Argentine ants, various slugs and the spider *Dysdera crocata*.

In August I surveyed the heap more carefully and collected some quick-running lithobiomorph centipedes. There was the native *Henicops maculatus*, the introduced *Lithobius microps* and something I didn't recognise.

The strange centipedes were small and golden, like our native *Anopsobius*. Unlike *Anopsobius*, they didn't roll up into a spiral when disturbed. There were hundreds of them in the heap. They seemed to be concentrated where the Argentine ants were thickest.

I sent specimens to Greg Edgecombe, who studies southern temperate lithobiomorphs (among other things) at the Australian Museum in Sydney (See *Nature Australia*, Autumn 2001). Greg suspects they're a new species of *Lamyctinus*, in the same family as our native lithobiomorphs.

Problem is, where did the Thing-in-the-Heap come from? I doubt that it's a native. In nearly 30 years of centipede-collecting in Tasmania, I haven't seen anything like it. The only *Lamyctinus* officially recorded from Australia, the introduced *L. coeculus*, is a quite different species which has been spread around the world by trade.

Of course, the Thing-in-the-Heap *could* be native. It's sometimes very hard to decide. In 1996 J.T. Carlton (*Ecology* 77: 1653-1655) proposed the useful term 'cryptogenic' for species which might be either native or introduced. Another cryptogenic Tasmanian centipede is the geophilomorph *Ballophilus australiae*. It's been found on Clarke Island in Bass Strait, on a walking track at West Head near Beaconsfield, and in 'improved pasture' on the coast just south of the Arthur River. *B. australiae* is widespread on the mainland, but is it really Tasmanian?

If Greg describes the Thing-in-the-Heap as a new species, our backyard in Penguin will become the type locality. Meanwhile, my wife has suggested that I look for the Thing in other Penguin gardens. She has plans for the heap, and she's reluctant to threaten the only known population of an interesting invertebrate, even if it is (probably) introduced.

Another introduced hymenopteran

[It's a bit unusual for Invertebrata *to reproduce an abstract from an unpublished paper, but this one has been widely circulated in the Tasmanian entomological community, and the results are of major importance. The paper may also have set a Tasmanian entomological record for Most Authors.* *- Ed.]*

Hingston, A.B., Marsden-Smedley, J., Driscoll, D.A., Corbett, S., Fenton, J., Anderson, R., Plowman, C., Mowling, F., Jenkin, M., Matsui, K., Bonham, K.J., Ilkowski, M., McQuillan, P.B., Yaxley, B., Reid, T., Storey, D., Poole, L., Mallick, S.A., Fitzgerald, N., Kirkpatrick, J.B., Febey, J., Harwood, A.G., Michaels, K.F., Russell, M.J., Black, P.G., Emerson, L., Visiou, M., Morgan, J., Breen, S., Gates, S., Bantich, M.N. and Desmarchelier, J.M. (in press) The extent of invasion of Tasmanian native vegetation by the exotic bumblebee *Bombus terrestris* (Apoidea: Apidae). *Austral Ecology*.

Abstract

Observations of the large earth bumblebee *Bombus terrestris* (L.) in native vegetation were collated to determine the extent to which this exotic species has invaded Tasmanian native vegetation during the first nine years of its introduction. The range of *B. terrestris* now encompasses all of Tasmania's major vegetation types, altitudes form sea level to 1260 m, and the entire breadth of annual precipitation in the state from over 3200 mm to less than 600 mm. Observations of workers carrying pollen, together with the presence of large number sof bumblebees, at many localities across this range indicate that colonies are frequently established in native vegetation. Evidence that colonies are often successful was obtained from repeated observations of the species during more than one year at particular sites. Unequivocal evidence of colonies was obtained from six National Parks, including four of the five in the Tasmanian Wilderness World Heritage Area (WHA). Indeed, it has been present in the WHA for at least as long as it has in the city of Hobart, where it was first recorded. In southwestern Tasmania, evidence of colonies was obtained up to 40 km from gardens, 61 km from small towns, and 93 km from large towns. Hence, contrary to previous suggestions, the species is established in the most remote parts of Tasmania and is not dependent on introduced garden plants. Given their strong record of invasion, it is likely that *B. terrestris* will form feral populations on the mainland of Australia and in many other parts of the world if introduced. Because of their likely negative impacts on native animals and plants, and potential to enhance seed production in weeds, the spread of bumblebees should be avoided.

Kebun-Raya Spider Taxonomy Workshop

December 12-14th 2001
University of Queensland St Lucia, Brisbane

This taxonomy workshop has been initiated in order to give 'budding spider taxonomists' the chance to expand their knowledge and recognition of the many spider families present in Australia. The workshop will be run over three 4-hour sessions on December 12th, 13th and 14th 2001, at the School of Life Sciences, Goddard Building, University of Queensland. Dr Robert Raven from the Queensland Museum will instruct participants on the morphological recognition of all Australian spider families and will share his knowledge of spider trapping techniques. Participants will be provided with a catalogue of Australian spiders, an html glossary on CD, and paper keys to families of Araneomorphae and Mygalomorphae. There will also be an opportunity to look at a variety of specimens from Australian spider families. Morning tea and lunch will be provided on each of the three days. All interested participants should be aware that Dr Raven will not be instructing the class at an elementary level. The purpose of the workshop is to build on previously acquired taxonomic knowledge. However, you don't need to be a spider expert! If you have a decent idea of spider morphology, you'll have no problems.

For more information contact Elisha Ladhams on (07) 3365 7354, (07) 3378 7262 or **eladhams@sols.uq.edu.au**.

FIRE ANTS *(continued from p. 1)*

placed on costs such as household repair and control, substantial decrease in property value of infested land, agricultural losses through injury or loss of baby livestock (fire ants can blind calves), impediment of machinery by nest mounds, infesting of stock feed, medical treatment of humans and their pets, time off work due to stings, and damage to schools and school property. These costs are substantial and by themselves justify the eradication attempts.

The social impact of fire ant is also important. As Australians, how much do we value our outdoor lifestyle? Fire ants restrict leisure-time in our backyards, make gardening a painful pastime, prevent children from playing in infested areas and make walking around in bare feet or thongs dangerous. Fire ants wreck BBQs!

Identifying the fire ant

RIFA are 2–6 mm long and brown, with a hefty sting. Apart from these characters, little more can be said of fire ant identification with the naked eye - or skin! After this, microscopic identification is necessary.

RIFA belong to the large subfamily Myrmicinae in the family Formicidae. In Tasmania, this subfamily is easily recognised by being small ants (usually < 1 cm long) with two nodes (swellings) on the petiole (waist) and small mandibles (jaws). The only other ants in Tasmania with two petiolar nodes are the Myrmeciinae, which include the notorious inchmen and jack-jumpers, all of which are much larger than RIFA and have prominent, long jaws. The Myrmicinae are represented by about 20 native species in Tasmania, including one species of *Solenopsis*. How do we know the difference between *Solenopsis invicta* and other native species? Enter the Bede Lowery collection – the best synoptic collection of Tasmanian ants in the State.

The Bede Lowery collection

Reverend Bede Lowery worked for the Roman Catholic Church in many parts of Australia. He worked at Latrobe and Devonport for several years up to his death in 1996 at age 72. Bob Taylor, a retired CSIRO entomologist, described Bede's work in the Australian National Insect Collection newsletter (*ANIC News* 7:4-6, October 1995, and 11:12, October 1997. Bede greatly extended the checklist of Tasmanian ants during his residence in the State. He deposited three synoptic collections of ants in Tasmania, one each in the State Museums (QVMAG and TMAG) and one at Forestry Tasmania. During August, the authors visited Craig Reid at QVMAG to get our heads around the Tasmanian Myrmicinae.

The Bede Lowery collection allowed us to see, in one place and at one time, all the ants of Tasmania. We quickly identified the ants most similar to *Solenopsis invicta*. The native species *Solenopsis froggatti* was readily discounted. It is minute (about 1 mm long) – much smaller than RIFA. More similar are species of the related genus *Monomorium*. They are about the same size as RIFA but can be separated on the basis of their antennae. Species of *Monomorium* have 11- or 12-segmented antennae, and the last three segments are swollen to form a small club. Species of *Solenopsis* have 10-segmented antennae, and only the last two segments are swollen to form a small club.

Bede's synoptic collection also proved useful when we received a quarantine alert for Little Fire Ant, *Wasmannia auropunctata*, which recently invaded Hawaii. This ant is like a tiny *Solenopsis*, much like the native *S. froggatti*. How do we distinguish this ant from native Tasmanian ants? Easy – our notes on Bede's collection reveal that *S. froggatti* bears no spines on its propodeum, but Little Fire Ant has a pair of large spines.

The Bede Lowery collection will continue to be useful for years to come. Using it, entomologists like ourselves can examine specimens for characters mentioned in books and thus develop our ant-identifying expertise more rapidly. Using the collection, we can now identify all ants to genus with ease, and with more time we could use Bede's collection to make species-level keys for any desired group of Tasmanian ants.

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Literary footnote

The scene is 'Runnymede' station in outback NSW in the 1880s. Tom Collins, a very minor government official, is passing the time with young Moriarty, an ambitious but lazy storekeeper:

'...Then why not take up some interesting study, and work it out from post to finish? Political Economy, for instance?'

'Anybody could do that,' replied the young fellow contemptuously. 'I want to distinguish myself.'

'Then I'll tell you what you'll do, Moriarty. Take a narrow branch of scientific study, and restrict yourself to that. Say you devote your life to some special division of the *Formicae*'

'The what?'

'*Formicae*. The name is plural. It embraces all the different species of ants.'

'Why, there's only about three species of ants altogether; and there's nothing to learn about them except that they make different kinds of hills, and give different kinds of bites. That sort of study would about suit you. Fat lot of distinction a person could get out of ants.'

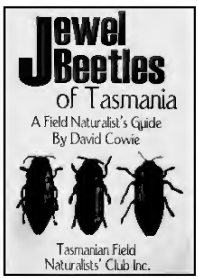
'Tom Collins' (Joseph Furphy),
Such Is Life (1903)

Notices & reviews

Tasmanian Field Naturalists Club. 2001. *Jewel Beetles of Tasmania: A Field Naturalist's Guide.* Hobart: Tasmanian Field Naturalists Club; 40 (42) pp. Paperback ISBN 0-9578529-0-8

Text by David Cowie, colour photographs by Les Rubenach. Edited by Don Hird, produced by Andrew Walsh, printed by Printing Authority of Tasmania. Price AUD $12 (or $15 posted within Australia) from the Tasmanian Field Naturalists Club Inc, GPO Box 68, Hobart TAS 7001.

Covers biology, life cycles, behaviour, foodplants, distribution, conservation, and classification. The *ca.* 50 species that occur in Tasmania are discussed, many of which also occur on the Australian mainland.



5th Invertebrate Biodiversity and Conservation Conference

1- 4 December 2001
Adelaide University, South Australia

(On-line registration available at: **www.waite.adelaide.edu.au/bio2001/registration.htm)**

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Speakers at the Adelaide conference's six scheduled symposia will include:

Impact of invasive species

Dennis O'Dowd (Monash University) - *Invasion meltdown*
Jacqueline Beggs (Landcare Research, NZ) - *Impact of an invasive social wasp on New Zealand's forest invertebrate community*
Chad Hewitt (CSIRO Marine Science) - *Diversity and potential impact of introducing marine invertebrates in Australia*

Invertebrate biodiversity of the arid zone & ephemeral waters

Alan Andersen (Tropical Ecosystems Research Centre, CSIRO Sustainable Ecosystems) - *Ant biodiversity in arid Australia*
Winston Ponder (Australian Museum) - *Mound Springs of the Great Artesian Basin - issues, progress and future directions*
Russell Shiel (Adelaide University), Stuart Halse (Wildlife Research Centre, Dept of Conservation and Land Management, WA) & John Green (University of Waikato, NZ) - *Microfaunal biodiversity in ephemeral waters: temperate and arid Australia*

Marine invertebrate biodiversity

Sean Connell (Adelaide University) - *Consequences of habitat fragmentation and invasion*
Pat Hutchings (Australian Museum) - *Polychaetes - their biological biodiversity - all is revealed*
Greg Rouse (Sydney University & South Australian Museum) - *Australian echinoderms: evolution, diversity and exploitation*
Ian Whittington (Queensland University & South Australian Museum) - *Biodiversity of marine parasites*

Habitat fragmentation: plant-invertebrate relationships

Tim New (La Trobe University)- *-Invertebrate conservation and impact/implications of habitat fragmentation: an overview*
Cathy Rufaut, Katharine Dickinson, Gerry Closs (University of Otago, NZ) & George Gibbs (Victoria University, Wellington, NZ) - *Habitat fragmentation in tall tussock grasslands: plant-invertebrate relationships*
Colin Ferguson (AgResearch, Invermay Research Centre, NZ) - *Impacts of burning on native grassland invertebrates: issues associated with sampling and data handling*
Barbara Barratt (AgResearch, Invermay Research Centre, NZ) - *Impacts of burning on native grassland invertebrates: initial response of weevil populations*
Barbara Downes (University of Melbourne) - *Habitat disturbance and plant -invertebrate relationships: lessons from stream habitats*

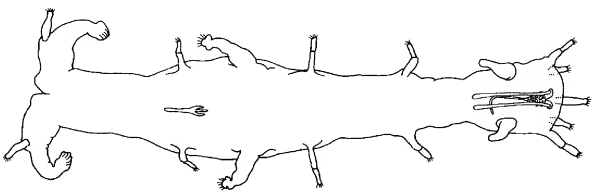
Molecular tools in invertebrate conservation

Ross Crozier (James Cook University) - *Phylogenetic considerations in conservation worth: concept and practice*
David Rowell (Australian National University) - *The impact of population dynamics on evolutionary radiation in Onychophora*
Paul Sunnucks (La Trobe University) - *Hidden diversity and unexpected biology in velvet worms revealed by molecular techniques*

Legislation & education

Geoff Clarke (CSIRO Entomology) - *ECOWATCH - getting kids involved in biodiversity*
Simon Nally (NSW National Parks and Wildlife Service) - *Another Copper Cuppa?*
John Vranjic (Wildlife Australia Branch, Environment Australia) - *Invertebrates and the EPBC Act*

What is it?



[Yes, it's Tasmanian. – Ed.]

A tale of two rare and threatened invertebrates

Sandy Leighton

In March 2001, a collaborative project on two rare and threatened invertebrates in the Launceston area was started with funding from the Threatened Species Unit within the Department of Primary Industries, Water and Environment, Tasmania (DPIWE). Both invertebrates have limited distributions, are listed as rare under the *Tasmanian Threatened Species Protection Act 1995* and require a damp, mossy habitat.

The project is hosted by the Launceston Environment Centre and additional funds have now been received from Hydro Tasmania, DPIWE (Threatened Species Unit and Parks & Wildlife Service) and a World Wide Fund for Nature grant to enable a twelve-month study of the two species. Partnerships have been established with the Launceston Environment Centre community volunteers, Launceston City Council, Queen Victoria Museum and Art Gallery, Conservation Volunteers 'Green Reserves' program and the University of Tasmania.

The project aims to:

- locate mossy environments (dolerite boulders, rotting wood and leaf litter) in the Launceston area, initially focusing on places where the species have already been recorded
- investigate the distribution and abundance of both invertebrates
- foster a greater understanding of threatened species conservation and management within the broader community, including direct training in habitat and species surveys and weeding trials and
- involve land and water managers in the conservation of both threatened species in areas under their jurisdiction.

Plomley's trapdoor spider

Plomley's trapdoor spider, *Migas plomleyi*, was first recorded in 1987 from the Cataract Gorge Reserve and described by Raven & Churchill (1989) from three accidentally collected female specimens. The specimens are lodged at the Queensland Museum. Their habitat was recorded as '...moss-covered boulders along the Cataract Gorge'. The conservation status of this species is Endangered under the Tasmanian criteria and Critically Endangered under the IUCN 1994 criteria at the Commonwealth level. *M. plomleyi* is one of three endemic mygalomorph spiders in the family Migidae found in Tasmania and the only one with an above-ground burrow. Females are stout with a body length of 6.4 mm and have a brown cephalothorax with a black abdomen. The thin parchment-like sac used for shelter (up to 2 cm long) is similar in colour to the surrounding moss or soil and is located at the moss/soil interface on dolerite boulders. The sac door is concave, thin and moss-covered, and opens directly to the outside. An above-ground, parchment-like shelter sac is typical of *Migas* in New Zealand but atypical for most Australian mygalomorphs. Population density is probably <3/100 m^2 in suitable habitat. *M. plomleyi* probably lives for five to 10 years, and their presence indicates soil stability (R. Raven, pers. comm. 2001). The spider is subject to predation by native wasps (and, we suspect, also European wasps) and is prone to death by flooding of burrows and burrow dislodgement. It is likely to quickly disappear from areas which are opened up by clearing, thus lowering the humidity of the microclimate (R. Raven, pers. comm. 2001).

Cataract Gorge snail

The Cataract Gorge snail *Pasmaditta jungermanniae* was described from the Cataract Gorge in 1879 by Petterd as *Helix jungermanniae*. It is a small to minute punctid land snail (2-3 mm diameter), slightly frosty/glossy and jet black/bronze in colour with no flecking or striping. The shell has a sculpture of very low, close riblets with faint spiral striae. It is easily confused with the more common and widespread *Planilaoma luckmanii*. *P. jungermanniae* occurs in small, widely spaced clusters of individuals and has been recorded from mossy boulders, leaf litter and rotting wood in the Cataract Gorge Reserve (1879), Notley Gorge (1984) and possibly West Arm (?) in the Tamar area.

Results

Surveys for mossy habitat were conducted in the Cataract Gorge Reserve, Trevallyn State Reserve, Corra Linn and Notley Gorge areas and rated for their quality/lushness. These areas are now being systematically searched for both species. To date three additional female *M. plomleyi* have been located (identified by Lisa Boutin, QVMAG), two in the Cataract Gorge Reserve and one specimen in the Trevallyn State Reserve. Pitfall traps have been set up in the Cataract Gorge in the hope of collecting wandering males looking for a mate. *P. jungermanniae* has been recorded from the Cataract Gorge Reserve only.

A collaborative program for the future management of both species has been set up involving environmental volunteers from the local community supported by land and water managers. The assessment of impacts on the quality of moss habitats is underway along with weeding and revegetation trials. Those impacts could come from fire, weeds, recreation (abseiling and rock-climbing) and high water levels (in Cataract Gorge), leading to flood-scouring of mossy boulders.

Agency stakeholders and their management issues are:

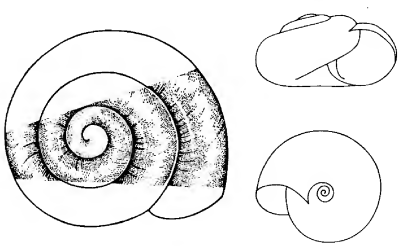
Launceston City Council manages Cataract Gorge Reserve and is concerned with weeds, recreation and habitat protection.

Hydro Tasmania manages water levels in the South Esk River in Cataract Gorge for power generation.

Parks and Wildlife Service (DPIWE) manages Trevallyn State Reserve and is concerned with recreation and habitat protection.

The Threatened Species Unit (DPIWE) is concerned with protecting the two invertebrates at both State and Federal level.

(continued on page 9)



Pasmaditta jungermanniae

Drawing by Rhyllis Plant from Smith, B.J. and Kershaw, R.C. 1981. *Tasmanian Land & Freshwater Molluscs. Fauna of Tasmania Handbook No. 5.* Hobart: Fauna of Tasmania Committee, University of Tasmania.

Odd Tales from the Overstorey

Your editor attended the joint conference of the Society of Australian Systematic Biologists and the Australasian Evolution Society in Melbourne in July. Invertebrates featured in 35 of the 80-odd talks and posters, but for me the highlights of the meeting were three presentations about gum trees. All three came from a eucalypt genetics research group at the University of Tasmania. Because the work of this group is so little known in the zoological community, I'm offering here an abbreviated and (hopefully) not too technical overview of their recent results. Be warned: your mind is about to be stretched.

Mt Arrowsmith

For some 40 years local botanists have known about a spectacular morphological gradient in the 'yellow gum complex' on Mt Arrowsmith, near Lake St Clair. Going downhill 1.5 km from the summit, the alpine shrub *Eucalyptus vernicosa* grades into the small tree *E. subcrenulata*, then into a much taller tree lower down which is sometimes classified as *E. subcrenulata* and sometimes as *E. johnstonii*. In southeast Tasmania the 'yellow gum complex' is spatially divided. *E. vernicosa* populations on top of Mt Picton and Hartz Mountain, for example, are well-separated from mid-elevation stands of *E. subcrenulata*, which on both of those mountains grades downslope into *E. johnstonii*.

How did this complex evolve? Did yellow gums at lower elevations give rise to *E. vernicosa* shrubs separately on each mountain? Or did *E. vernicosa* arise just once from a yellow gum ancestor and disperse across the State over time?

To find out, the UniTas group took leaf samples from yellow gums on all three mountains and analysed them both morphologically and genetically (McGowen *et al.* 2001). The genetic testing was based on electrophoretic separation of microsatellite DNA from leaf cell nuclei. In both analyses, the yellow gums grouped themselves into two classes: high-elevation *E. vernicosa* and *E. vernicosa*/*E. subcrenulata* intermediates, and lower-elevation *E. subcrenulata* and *E. johnstonii*.

In other words, *E. vernicosa* on Mt Arrowsmith is more closely related to *E. vernicosa* on Mt Picton than it is to the taller Mt Arrowsmith yellow gums. The idea that this shrub eucalypt evolved separately on each mountain isn't supported.

And the gradient on Mt Arrowsmith? Well, what looks like gradual variation in a single lineage is no such thing. Instead, there's a mountaintop yellow gum and a lower-elevation yellow gum. They meet at middle elevations and converge to the same morphology from different directions.

Sharing

The Mt Arrowsmith story warns us that the appearance of a eucalypt isn't a reliable indicator of its evolutionary history. From here on, the genetic results reinforce that idea and are very strange indeed.

McKinnon *et al.* (2001) looked at the DNA in eucalypt leaf chloroplasts, or 'cpDNA' for short. Like mitochondrial DNA, cpDNA is maternally inherited. A eucalypt's cpDNA comes from its seed 'Mum', not its pollen 'Dad'.

The UniTas group extracted cpDNA from 17 species in the subgenus *Symphyomyrtus*, which in Tasmania are the black, white, yellow, blue and alpine white gums. Leaves were sampled across the range of each species in the State. A particularly variable stretch of the chloroplast genome, the J_{LA} region, was sequenced, and the relatedness of the sequences from different samples was analysed using molecular genetic measures.

The group found that their 157 samples contained 15 different J_{LA} sequences, or haplotypes. These could be grouped into four families: J_c, J_s, J_i and J_{et}. If the conventional 'branching tree' model of evolution applied here, you would expect these four to be sorted out neatly by branches.

They aren't. Instead, the four families are scattered unpredictably among the 17 species. More remarkably, the haplotype families are geographically patterned. J_s, for example, is found in 12 of the 15 *Symphyomyrtus* species in Tasmania's southeast, but is completely absent from the north and west. Eucalypt species which carry J_s in the southeast carry J_c, J_i or J_{et} elsewhere. The J_i family lives in the southwest, where it's shared by *E. globulus*, *E. ovata* and *E. vernicosa*. J_{et} occurs on the east coast north to St Marys and west to Lake Augusta on the Central Plateau; it's carried by *E. archeri*, *E. barberi*, *E. globulus*, *E. gunnii*, *E. rubida* and *E. viminalis*.

Something very odd is going on. If cpDNA is passed from seed parent to seed parent, how can haplotypes jump across species boundaries — and why do they respect geographical ones?

Reticulation

The explanation favoured by the UniTas group is that there has been extensive past hybridisation in Tasmanian eucalypts.

Once upon a time there were separate cpDNA lineages. The climate deteriorated, and for thousands of years the separate lineages lived close to each other in small refuges in the landscape. The lineages couldn't swap chloroplast genes, but they could hybridise and share the genes carried by pollen. These pollen genes are nuclear and include those which determine morphology. Eucalypt *A* passed its cpDNA from generation to generation, but after many generations of being rained on by eucalypt *B* pollen, the hybridised descendants of *A* began to look like *B*, and to share *B*'s habitat preferences.

This process happened repeatedly during the glacial/interglacial cycles of the Pleistocene. During interglacials, the hybridised lineages left their refuges and sorted themselves in the landscape according to their pollen ancestry. *E. globulus* near St Marys may look like *E. globulus* near Hobart, but its seedline history means it may contain residual genes of the semi-alpine *E. gunnii*.

With the shuffling of eucalypts among refuges during successive glacial/interglacial cycles, cpDNA sharing could even occur between morphological species *A* and *C*, which cannot hybridise, by a 'stepping-stone' model in which *A* hybridises with *B*, which later hybridises with *C*.

This is reticulate evolution on a massive scale, a mixing of lineages through time like the mixing of water currents in a braided stream. It would be interesting enough in a pair of species. In 14 of our 17 gums, it's extraordinary. There is also genetic evidence

(continued on page 7)

(continued from page 6)

(McKinnon *et al.* 1999) for reticulate evolution in the Tasmanian ash and peppermint eucalypts.

Blue gums from where?

Another cpDNA study looked at *E. globulus* throughout its range in Tasmania and in parts of Victoria (Freeman *et al.* 2001). A larger region of the chloroplast genome was sequenced ('J_{LA}+', 987 base pairs), yielding a data matrix with 40 variable characters in 270 samples. The matrix was analysed using phylogenetic methods.

Results confirmed previous studies using smaller molecular data sets. There are three major cpDNA lineages in Tasmanian blue gum: J_c, J_s and J_{et}. The J_c lineage also occurs in mainland Australian populations, along with two haplotypes not found here.

I mentioned above that J_s and J_{et} are geographically restricted in Tasmania. Analysis of the much more widespread J_c family uncovered a fascinating geographical substructure. One J_c subgroup is restricted to mainland Australia and the Furneaux Group in eastern Bass Strait. A second subgroup occurs in the Otways in Victoria, on King Island in western Bass Strait and in mainland Tasmania, but not in the Furneaux Group. In southeast Tasmania, J_c subgroups are regionalised, with narrow transition zones.

The genetic and spatial patterns suggest that the J_s and J_{et} lineages haven't moved very far from glacial refuges in the southeast and on the east coast, respectively. The J_c data indicate that the most recent land contact between Tasmania and Victoria was through western Bass Strait. Down that path came J_c blue gums. When they reached southern and eastern Tasmania, they hybridised with J_{wt} (Port Davey), J_s and J_{et} eucalypts, creating blue gum 'look-alikes' from non-blue gum seed donors.

Back to bugs

The work of the UniTas group is revealing extraordinary and unexpected patterns in eucalypt evolution in Tasmania. Most of the geographical patterning, however, looks pretty familiar to those of us who study slow-dispersing invertebrates like land snails, millipedes, landhoppers and stag beetles. Shared patterns indicate a shared history. While eucalypts were hybridising in refuges, invertebrates were living in their leaf and woody litter, and when the gum trees left the refuges, the invertebrates followed. An interesting question now arises: which of those invertebrates are 'good' species, and which — like our eucalypts — are reticulate mixtures of lineages?

Bob Mesibov

More information:

Freeman, J.S., Jackson, H.D., Steane, D.A., McKinnon, G.E., Dutkowski, G.W., Potts, B.M. and Vaillancourt, R.E. 2001. Chloroplast DNA phylogeography of *Eucalyptus globulus*. *Australian Journal of Botany* 49:589-596.

McGowen, M.H., Wiltshire, R.J.E., Potts, B.M. and Vaillancourt, R.E. 2001. The origin of *Eucalyptus vernicosa*, a unique shrub eucalypt. *Biological Journal of the Linnean Society* 74 (in press).

McKinnon, G.E., Steane, D.A., Potts, B.M. and Vaillancourt, R.E. 1999. Incongruence between chloroplast and species phylogenies in *Eucalyptus* subgenus *Monocalyptus* (Myrtaceae). *American Journal of Botany* 86: 1038-1046.

McKinnon, G.E., Vaillancourt, R.E., Jackson, H.D. and Potts, B.M. 2001. Chloroplast sharing in the Tasmanian eucalypts. *Evolution* 55: 703-711.

Notices & reviews

Butterflies in the Pine Rivers Shire (two-sided colour poster, 60 x 42 cm). Produced by Pine Rivers Shire Council, August 2001. Available from Department of Development and Environment, Pine Rivers Shire Council, PO Box 5070, Strathpine QLD 4500.

'This publication packs a lot of information into a small space and still manages to look attractive. There is basic information for beginners such as on the butterfly life-cycle but everything is still scientifically accurate. The poster takes up one whole side and lists 61 butterflies and the host plants for their caterpillars. Twenty-three of these butterflies are illustrated with photos. This provides useful information for those contemplating a butterfly garden.

'It was good to see that some caterpillar photographs were included and that the mistletoe butterflies were not left out. While there are several books covering all of Australia's butterflies this poster concentrates on those to be found in the Pine Rivers Shire. The Shire Council is to be commended for producing this brochure/poster and no doubt many people will date the beginning of their interest in butterflies from when they first saw it.'

Frank Jordan
Butterflies & Other Invertebrates Club Inc Newsletter No. 22, September 2001; p. 14 (with thanks to BOIC)

Historical footnote

The Royal Society of Van Diemen's Land (forerunner of the Royal Society of Tasmania) held monthly meetings in Hobart in the late 1840s. Tabled at the meetings were examples of 'the natural productions of this island': plants, animals and geological specimens. Most of the items are recognisable from their descriptions, but this one is a bit mysterious:

> The Secretary submitted a small (probably undescribed) hairy Crab, caught about the level of low-water mark on the rocks near "the Snug" point, in D'Entrecasteaux Channel. It is remarkable for the size and comparative strength of its claws, and for its lurking in a state of perfect concealment under a red membrane-like covering, from which it springs on its unwary prey. It much resembles the *Dromia hirsutissima* of the Cape of Good Hope.
>
> *Papers and Proceedings of the Royal Society of Van Diemen's Land* 1(3), 1851; p. 272.

Dromiid crabs often carry a 'red membrane-like covering' of living sponge on their carapace, but their claws aren't especially large. Another common low-intertidal crab, Lomis hirta, *has very large claws and is hairy, but doesn't carry a sponge 'mantle'. What got tabled at that meeting?*

Wanted!

Reports of 'people news' and invertebrate goings-on from DPIWE, Inland Fisheries Commission, CSIRO Marine Labs, University of Tasmania departments and any other agencies, institutions or individuals studying invertebrates in Tasmania. Pictures are very welcome, both to illustrate animals under discussion and to make *Invertebrata* look more interesting. Contributed pictures should preferably be black-and-white line illustrations, not in colour and not in a range of grays. Illustrations can be e-mailed in any image format, preferably zipped if not .jpg.

Please note: the deadline for the February 2002 issue is Friday, 1 February.

Asterias amurensis and Henderson Lagoon

In the July issue (#20) of *Invertebrata*, we reported on finds of the introduced pest, *Asterias amurensis* (Northern Pacific Seastar), in Henderson Lagoon in Tasmania's Northeast, which marked a significant expansion of its known range in our waters. What made this range expansion particularly interesting from the point of view of pest management was, that for probably the first time anywhere in the world, a significant population of these sea-stars became an entrapped population within an embayment, sealed off from outside waters.

During recent decades Henderson Lagoon has been primarily a tidal estuary, open to the sea at its southern end, but with the occasional closure at the mouth with a massive sand-build following big easterly swells. In early March this year, the lagoon mouth was closed by just such a sand bar, just three weeks after the first specimens of *A. amurensis* were found by biologists from the Centre for Research on Introduced Marine Pests (CRIMP). At that time I, along with others, made the prediction that with the onset of post-summer rains and the input of freshwater from the many creeks feeding into the lagoon, that the subsequent reduction in salinity of the lagoon waters would result in the demise of all the entrapped *A. amurensis*. This prediction was based on all the available information on salinity tolerances of this species in the scientific literature: 24 parts per thousand (ppt) was considered its lowest threshold (Marsh 1993, Morrice 1995). However, as reported in our earlier article, the seastar defied our predictions and proved it could survive, and in fact live quite happily, at salinities well below this level.

The closure of Henderson Lagoon to outside waters by natural forces was viewed by many as a blessing and by others as a curse. It was viewed as a blessing by those who saw the entrapment as an opportunity to eradicate the seastar population from the lagoon before it could act as a point source for spread further afield, and also by those who saw it as an opportunity to obtain valuable scientific information on the true environmental tolerances of this pest species.

The negative aspects of the lagoon closure were the impacts to the terrestrial environments surrounding the lagoon, as water levels rose and the lagoon boundary widened. The farmer whose farmland adjoins a large proportion of the western shores of the lagoon reported damage to his pasture from the flooding, loss of stock through drowning and other impacts on his farming activities. Managers/custodians of the Winifred Curtis private botanical reserve at the northern end of the lagoon reported damage to vegetation in flooded areas and were frustrated by being unable to commence a 'Work for the Dole' project in the reserve due to the inundation. A third potential impact and cause for concern was the possibility of flooding of the Tasman Highway near Peat Marsh if the water level in the lagoon continued to rise with winter rains. Suffice to say, there were very vocal and passionate spokespersons in both the 'It's a blessing' and 'It's a curse' camps. As is often the case, Tasmanian Parks and Wildlife staff were caught in the middle and adopted the unenviable role of mediators between those wanting the lagoon to stay closed and those wanting it opened as soon as possible.

Meanwhile, oblivious to all the above-water jostling, down amongst the relative quiet of the sandy/silt bottom of the lagoon, *A amurensis* continued to amaze biologists with its resilience to ever-decreasing salinity. On 11 June the first eradication effort was mounted by members of the Falmouth community and surrounding districts, with involvement from CRIMP, Parks and Wildlife, and Marine Resources Division. Although 401 seastars were removed from the lagoon, it was clear to everyone at the end of that day that many more remained. A second eradication effort was organised for 15 July, but nature intervened once more with heavy rains and forced a postponement, as visibility in the lagoon waters fell to near zero.

In the weeks that followed CRIMP scientists, with assistance from several Falmouth residents, made several collections of seastars for laboratory salinity tolerance trials, and for examination of reproductive condition. It was obvious from these collections that the seastars in the lagoon were becoming sexually mature, in synchrony with the normal seasonal pattern observed in populations in southeast Tasmania, i.e. ripening of male and female gonads through June and July in the lead-up to spawning in August/September. The results of laboratory salinity trials, which were supported by *in situ* field observations, showed *A. amurensis* could survive at salinities even as low as 12 ppt if changes in salinity were gradual. Some of the seastars collected from the lagoon at these low salinities were found to be actively feeding on bivalves and gastropods, and appeared very healthy.

The second community-based eradication effort was planned for 12 August. During the two days prior to this Sunday, the lagoon was marked out into search zones with ropes and coloured buoys. 'Dummy' seastars (*Asterias* of similar size to those of the lagoon population, which had been dried, coated in resin, and weighted with lead sinkers) were seeded into the zones to be searched by teams of snorkellers. These dummies were to provide a measure of success of the eradication effort. Twenty-four divers from across the State worked in cold and overcast conditions, hampered by poor underwater visibility, especially in deeper areas of the lagoon. Another 25 people assisted with driving or paddling support boats, ferrying divers to and from the search zones and retrieving catches, and with measuring and recording the seastars and feeding the volunteers.

From the point of view of community involvement, the day was a great success. As with the eradication day in June, the 12 August effort clearly demonstrated the concern people have in our community about marine pest issues and their willingness to do something about controlling them. However, the day was not a resounding success from the point of view of pest control. Divers collected 238 live *A amurensis*, but only 19 of a possible 42 dummy seastars were retrieved from six search zones, suggesting that at least another 340 live *A. amurensis* were still at large in the lagoon. This is a conservative estimate as the placing of the dummy seastars meant that they were more likely to be collected than the real thing. The majority of the seastars appeared healthy, in full spawning condition, and many exuded eggs and sperm while being handled. Bottom salinity in the lagoon was still in the range 11 - 15 ppt.

Moves to reopen the lagoon mouth to the sea intensified during the two weeks following the second eradication effort, and on the morning of 31 August a bulldozer was employed by the aforementioned farmer to do the job. Needless to say, this action, perceived by many to have occurred with insufficient warning and public consultation, created considerable acrimony, particularly amongst Falmouth residents vehemently opposed to any human interference in the lagoon's natural processes.

A CRIMP biologist surveyed the lagoon the day before the opening (without knowing the lagoon would be opened the next day) and collected four *A. amurensis*, which all appeared healthy and still happy at around 12 ppt. A CRIMP team surveyed the lagoon again five days after the opening of the mouth, and could find no trace of live *A. amurensis*.

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(continued from page 8)

Numerous dead and decaying seastars were found, and many powdery whitish patches on the bottom where the seastars had died and almost completely decayed. It is thought that the seastars were most likely killed by a sudden salinity change — either a sharp increase in salinity with the renewed tidal exchange post-opening, or a sharp decrease in salinity on the lagoon bottom with a breakdown of the stratification that existed pre-opening. It is likely a full tidal exchange regime would have taken a few days to re-establish in the lagoon, so a sudden shift to higher salinity levels is unlikely. Some of our early laboratory trials showed the seastars could survive a sudden transition from 16 ppt into 'full strength' seawater (i.e. 34 - 36 ppt), so we tend to favor the 'sharp decrease' scenario.

Plankton samples from the lagoon, taken by CRIMP in the lead-up to and at the time of the second eradication effort, and on the day before the opening of the mouth, did not contain any seastar larvae. Trials with larvae spawned and tested in the laboratory suggest that the larval survival rate in the low-salinity lagoon waters would most likely be low. Other trials also suggested the larvae would not survive the dramatic increase in salinity if they were advected out into the sea after opening of the lagoon mouth. However, these trials were not definitive, and can by no means be taken as a guarantee that the opening of the lagoon, while it contained a captive breeding population of a very invasive marine pest, will not result in the appearance of populations of the seastar in the Northeast during the coming summer. Conversely, if the seastar does appear in large numbers this summer in other Northeast embayments such as Georges Bay, there may be no link to the 2001 population in Henderson Lagoon: it may instead be the result of developing patterns of wider dispersal of larvae from populations to the south or even from the north (Port Phillip Bay).

By far the most pleasing aspects of the Henderson Lagoon 'saga' for CRIMP were the very significant contributions of time and effort by numerous community individuals and groups in attempting to rid one of our State's beautiful estuarine habitats of a noxious marine pest, and their genuine interest in introduced marine pest issues. Those people and groups are too numerous to mention here, but on behalf of CRIMP and Tasmania I (CP) thank them again.

As a somewhat depressing aside, during the *Asterias* saga, CRIMP biologists continued their monitoring of the *Carcinus maenas* (European green crab) population in Henderson Lagoon. Even when bottom salinity was at its lowest, egg-bearing *C. maenas* were still being found, and the post-opening survey in early September confirmed many small *C. maenas* had survived the six months when the lagoon was closed to the sea.

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Further information on community eradication efforts can be found at: **www.users.bigpond.com/falmouth**

More information:

Marsh, S.E. 1993. The biology and distribution of the introduced seastar *Asterias amurensis* (Lutken) (Echinodermata: Asteroidea) in Tasmania. Unpublished Honours thesis, University of Tasmania.

Morrice, M.G. 1995. The distribution and ecology of the introduced Northern Pacific Seastar, *Asterias amurensis* (Lutken), in Tasmania. Final report to the Australian Nature Conservation Agency.

SPIDER AND SNAIL *(continued from page 5)*
Future project direction

As the project continues we will

- Continue to assess and monitor impacts on the quality of mossy habitats and liase with the appropriate land and water managers
- Write Listing Statements for both species (including Action Plans)
- Aim for formal listing of both species at the Commonwealth level
- Engage stakeholders in formal management agreements for the protection of both species.
- Increase public awareness of threatened species with interpretive panels funded from a World Wildlife Fund grant in cooperation with the Launceston City Council
- Educate and engage environmental volunteers to enhance, restore and establish key habitats for both species (WWF grant)
- Continue to survey for both species.

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More information:

Raven, R.J. 1989. A new species of *Migas* (Araneae, Migidae), with notes on *Heteromigas* in Tasmania. *Bulletin of the British Arachnological Society* 8(1): 5-8.

Bryant, S.L. and Jackson, J. 1999. *Tasmanian Threatened Species Handbook: What, Where and How to Protect Tasmania's Threatened Animals.* Hobart: Threatened Species Unit, Parks and Wildlife Service.

Plomley's trapdoor spider, *Migas plomleyi*
(from a photograph)

Invertebrates in the media

Government report says 600 species face demise

Tassie's near-extinction list

The extinction of an overwhelming 600 species of native Tasmanian plants and animals is imminent, says a new report.

A draft conservation report says the state's rich variety of fauna and flora is in urgent danger because of overexploitation and neglect.

It has 63 recommendations which, if adopted, could result in permanent protection for more native forests, conservation assessments before native forest and vegetation clearing, stricter quarantine measures and greater funding for conservation.

The report, prepared for the State Government and released yesterday for public comment, said 33 native plant and animal species were extinct and another 600 were perilously close.

The report said seven weeds of national concern and another 142 noxious weeds were in Tasmania.

A massive effort was needed to control just a few.

Also, most pristine areas such as the South-West World Heritage Area and Macquarie Island were threatened by weeds and feral animals.

The draft Tasmanian Nature Conservation Strategy was released for comment at The Tasmanian Museum and Art Gallery yesterday.

State Biodiversity Committee chairman Bruce Davis said the strategy's key objective was the long-term protection of Tasmania's biodiversity and geodiversity.

"You can't protect the animals or invertebrates if you don't protect their habitats," he said. "We are suggesting a range of ways of ensuring the protection of our living natural assets but we have also recognised we need to be making similar efforts to preserve non-living features and processes, such as rocks, fossils, landforms, soils and water, which are fundamental to our living systems.

"Particular forest communities are under threat.

"If we continue our current rate of clearance, we're not even going to meet the Regional Forest Agreement in 20 years."

The plan is available at www.dpiwe.tas.gov.au or phone 6233 6556, or email biodiv@dpiwe.tas.gov.au.

[With a photo of the State Biodiversity Committee chairman and a stuffed fox, captioned *FOXING AROUND: Bruce Davis and a feral pest.*]

The Saturday Mercury newspaper, Hobart
7 July 2001, p. 10

* * *

'*...animals or invertebrates...*'? Perhaps just a slip of the tongue. Unfortunately, '*...and another 600 species were perilously close*' is nearly a direct quote from p. 3 of *Tasmania's Nature Conservation Strategy* (TNCS). TNCS refers its readers to Table 5 of the report, which notes that 454 plants and 154 animals are on the State threatened species list. Perhaps we should stop categorising species as 'endangered', 'vulnerable' and 'rare' under the *Threatened Species Protection Act*, and just call them all 'Perilously close to extinction'?

Despite this lapse and the weak reportage in *The Mercury*, TNCS is well worth reading, as it presents strategy-level recommendations on all aspects of nature conservation in Tasmania. 'Strategy-level', of course, means that many of the 64 TNCS recommendations are deliberately vague. How they're to be implemented will be discussed in a TNCS Action Plan, to be released after public comments on TNCS have been considered. We can expect that commercially important recommendations will have priority, because TNCS tells us that '*The development of Tasmania's Nature Conservation Strategy has provided a timely opportunity to strategically review many issues affecting Tasmania's natural resources. Some major issues have emerged which will influence how we do business locally, nationally and internationally*' (p. 36).

'We' who are involved with invertebrates in a non-commercial way can find the usual messages in TNCS. Tasmania has a rich and richly endemic invertebrate fauna. We don't know a lot about it. Many invertebrates are threatened by a range of inappropriate uses of the land and its waters, and the sea. We need to do more invertebrate surveys and research, we need more comprehensive fauna inventories when monitoring the environment, and we need to know more about invertebrate species which may be threatened.

You can find each of these points in conservation strategies, plans, reviews, policy documents and position papers going back some 25 years. Some of them can be traced to an article published 80 years ago by Baldwin Spencer*. All of them will undoubtedly appear again in future documents in the TNCS lineage.

In September, a senior staff member of the Nature Conservation Branch within DPIWE addressed an invertebrate conservation workshop in Launceston. He pointed out that Tasmania has an admirably high proportion of its land area in reserves, and that we have many more invertebrates on our threatened species list than any other State. We are moving rapidly towards improved conservation on non-reserved land, and invertebrates already figure largely in our forest practices system and in environmental monitoring generally.

On the negative side, the DPIWE officer pointed out some of the impediments to conserving invertebrates by 'traditional methods', such as focusing on single species and finding an appropriate spatial scale at which to manage habitats. Another issue is that we don't know whether existing reserves are actually doing the job we hope they're doing, because we know so little about the invertebrates in those reserves. And, of course, it's hard to get money from politicians to conserve 'non-charismatic' animals. The result: we have to accept, said the DPIWE officer, that we will lose invertebrate species in coming years.

It was a good address, just as TNCS is a good overview. The State Biodiversity Committee and its helpers can't be accused of ignorance of invertebrates and their importance. Nevertheless, the prospects for invertebrates post-TNCS are likely to remain the same as they were pre-TNCS: not nearly enough attention will be paid to the 95% of our fauna that's neither mammal, bird, snake, lizard, frog or fish.

The problem today, as it has been for the last 80 years, is that invertebrates have a low priority in nature conservation. TNCS has not addressed this problem and offers no strategies for change. The 'neglect' referred to in *The Mercury* article will continue.

*Spencer, B. 1921. The necessity for an immediate and co-ordinated investigation into the land and fresh-water fauna of Australia and Tasmania. *The Victorian Naturalist* 37(10): 120-122.